PROCEEDINGS

OF THE

CALIFORNIA ACADEMY OF SCIENCES

FOURTH SERIES

Vol. XXXVII, No. 22, pp. 567–574; 15 figs. November 23, 1971

THE CARBONIFEROUS GENUS *GLYPTOCHITON* DE KONINCK, 1883 (MOLLUSCA : POLYPLACOPHORA)

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The genus *Glyptochiton* was established by L. G. de Koninck in 1883 for some unusual fossils from the Carboniferous beds at Tournai, Belgium. These were described originally by him as *Chiton? cordifer*, which he designated as the type of his genus. Subsequently, four additional species of fossil chitons were described that can be assigned to *Glyptochiton*. These are: *Chitonellus youngianus* Kirkby in Young, 1865, from the Lower Carboniferous Main (or Hurlet) limestone at Craigenglen, Campsie, Ayrshire, and from Cunningham Baidland, near Dalry, both in western Scotland; *Chitonellus subquadratus* Kirkby and Young, 1867, from the same strata; *Chitonellus quadratus* Etheridge, 1882, and *C. kirkbyanus* Etheridge, 1882, also from the same strata.

All of the earlier illustrations of the valves of *Glyptochiton* are stylized drawings. For this reason advantage is taken to provide photographs of a series of valves labeled "*Glyptochiton cordifer* de Kon./carbe-Kalenskalk/Tournai/Belg." in the collection of the United States National Museum (Natural History), Division of Paleontology, no. 63404, which were loaned for study through the courtesy of Dr. G. Arthur Cooper. Because of the nature and the considerable age of the original label (headed "Comptoir Belge de Mineralogie & de Paleontologie/Ad. Piret-Tournai") it seems reasonable to assume that these valves are from the type locality of *G. cordifer*, perhaps identified by de Koninck himself. The six specimens in the set include a head and tail valve and four intermediate valves. So far as I know they are the only currently available representatives of the species in North America.

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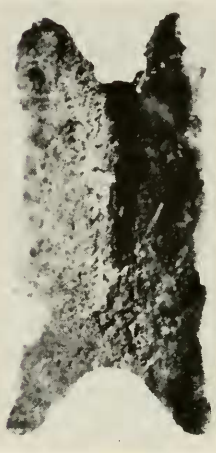

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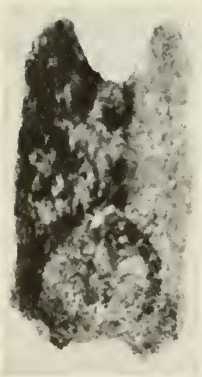

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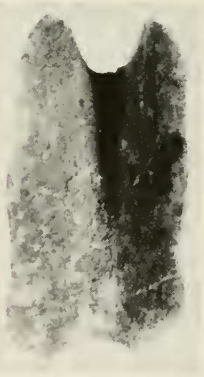

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The tegmentum of the head valve (fig. 1) has no particularly marked sculpture but the dorsal side of the rather wide insertion plate has very faint, irregular, closely spaced grooves across it. This valve is about as wide as long; it is not much thickened on the ventral side (fig. 2).

The tegmentum of intermediate valve A (fig. 3) consists of a raised, slightly overhanging, heart-shaped ridge forming an area 4.0 mm. long and 3.4 mm. wide, the point of the heart directed toward the anterior end of the valve; the area inside the ridge is much depressed with a prominent elongated tubercle situated at its center and extending anteriorly until it reaches the point of the heart-shaped ridge. On the dorsal side of the articulamentum of this valve there appears to be slight evidence of faint grooves similar to but weaker than those on the articulamentum of the head valve. However, across the porterior sinus (at the broad end of the heart-shaped ridge) there is a series of 8 closely spaced, low, narrow, short ridges bounded by narrower channels that extend under the small overhang of the tegmentum. Like the head valve, intermediate valve A is not appreciably thickened on the ventral side (fig. 4). The angle of divergence of the side slopes is 86° (fig. 9).

Intermediate valves B, C, and D (figs. 5–8, 10–11, inclusive) have much the same sized heart-shaped tegmentum, although the preservation of these is such that there is only the faintest suggestion of the occurrence of the series of grooves, or 'pectinations,' across the posterior sinus described for intermediate valve A.

The tail valve (fig. 12) has a semicircular posterior margin, with side margins that taper inward slightly toward what remains of a shallow anterior sinus. The tegmentum on this valve is well marked, with the edges slightly overhanging the articulamentum, forming a distinct eave, and has a prominent, laterally pinched-up mucro placed centrally and extending longitudinally almost to the anterior tegmentum margin. The shape of the tegmentum area is somewhat heart-shaped also, but with a semicircular posterior end opposite the point of the heart. The area occupied by the insertion plate is extensive toward the anterior end of the valve but becomes quite narrow about its middle and extends all the way around the semicircular posterior margin as a short, almost vertical ledge equal to the

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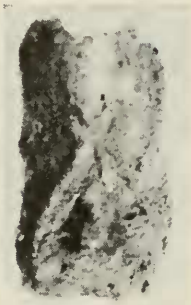
FIGURE 1. *Glyptochiton cordifer* (de Koninck, 1844). Head valve; dorsal view. U. S. National Museum no. 63404. Length, 6.1 mm. FIGURE 2. Head valve; ventral view. FIGURE 3. Intermediate valve A; dorsal view. Length, 11.4 mm. FIGURE 4. Same; ventral view. FIGURE 5. Intermediate valve B; dorsal view. Length, 10.4 mm. FIGURE 6. Same; ventral view. FIGURE 7. Intermediate valve D; dorsal view. Length, 9.3 mm. FIGURE 8. Same; ventral view. FIGURE 9. Intermediate valve A; posterior end view showing valve thickness and an 86° angle of divergence of side-slopes. Height, 3.4 mm. The pectinations across the posterior sinus under the slight overhang of the heart-shaped tegmentum show faintly in this view.



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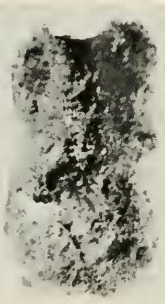

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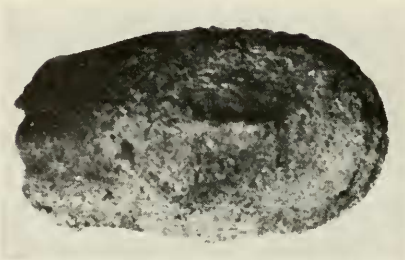

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thickness of the valve's articulamentum layer. This insertion-plate ledge is coarsely but closely pectinated, as shown in figs. 14 and 15.

The measurements of the valves are as follows:

Measurement (mm.)	*Head*	*Valve A*	*Intermediate Valve B*	*Valve C*	*Valve D*	*Tail*
Length	6.1	11.4	10.4	7.9	9.3	10.0
Width	6.5	4.6	4.0	4.0	4.7	5.9
Height	3.3	3.4	3.3	2.8	3.5	3.4

Older paleontologists doubted that *Glyptochiton cordifer* was, in fact, a chiton. de Ryckholt (1845) thought it might be a crinoid plate and so also did Dall (1882) and Rochebrune (1883). According to Salter (1847), even de Koninck himself admitted it might be "an encrinital plate", although he considered it definitely to be chitonoid when he established the genus *Glyptochiton* for it.

There seems to be little doubt now that *Glyptochiton* is polyplacophoran. What is considered to be the tegmentum layer of the valves is similar in general configuration to that in the Recent genus *Amicula* in which the valves are buried deeply in a thick, muscular girdle with only small, heart-shaped areas exposed in the intermediate valves. The tegmentum of the valves in the Recent genus *Choriplax* from Australia also are somewhat similar, although the areas of the articulamentum of these valves are not at all similar to those in *Glyptochiton* and the overall valve outlines are not at all comparable.

No species of chiton similar or referable to *Glyptochiton* has been reported in the Paleozoic other than from the Carboniferous of Belgium and western Scotland. There are no comparable Mesozoic species known. This suggests that the evolutionary line represented by *Glyptochiton* may have been an offshoot from the main trend of chiton development, which came to an abrupt dead end in the Paleozoic for reasons that certainly are presently unknown. It seems likely, also, that the heart-shaped tegmentum areas in the intermediate valves of *Amicula* and *Choriplax* are of relatively recent origin. The only fossil record for the former genus is *Amicula vestita altior* Carpenter in Pilsbry, 1893, from the Pleistocene drift of Lower Canada; valves of *Choriplax* so far have not been reported to occur as fossils.

The intermediate valves of *Glyptochiton* are unique in configuration compared with all known Recent and fossil Polyplacophora. No other chiton valves

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FIGURE 10. *Glyptochiton cordifer*. Intermediate valve C; dorsal view. Length, 7.9 mm. FIGURE 11. Same; ventral view. FIGURE 12. Tail valve; dorsal view. Length, 10.0 mm. FIGURE 13. Same; ventral view. FIGURE 14. Same; end view showing insertion-plate pectination. Width, 5.9 mm. FIGURE 15. Same; from left side showing extent of the anterior portion of the articulamentum, pectination of the insertion plate, and position of the mucro.

are known that are so highly elongate and, at the same time, have rather deep sinuses at *both* ends terminating laterally in quite pointed processes at the corners. Even of greater significance is the occurrence, apparently for the first time in chiton evolutionary history, of grooved or pectinated insertion plates. Chitons with this type of insertion-plate sculpture so far have been considered by chiton specialists to represent the highest evolutionary development characterized by species placed in the family Chitonidae as now restricted. The oldest species with such insertion plates have been reported from the Cretaceous (Berry, 1939; Smith, Yochelson, and Sohl, 1968). In modern chitons with pectinated insertion plates, the pectinations occur usually on both head and tail valves and along the side margins of the intermediate valves; also, the insertion plates generally are cut by a varying number of slits, which divide the plate into "teeth." In *Glyptochiton*, however, the tail valve is the only one seen with well developed pectinations in the insertion plate (figs. 14–15); in the intermediate valves such pectinations as there are occur in a small area at the base of the posterior sinus where they are not nearly so well developed. *Glyptochiton* valves have no slits or "teeth" unless the sculptural character here interpreted as pectinations (which are more rounded and less sharply defined than in species in the Chitonidae) is in reality the forerunner of extremely closely spaced "teeth."

The following summarizes all of the known published references to the four species of *Glyptochiton* mentioned earlier in this report:

Glyptochiton cordifer (de Koninck, 1844)

Chiton? cordifer de Koninck,1844, p. 324, pl. 22, figs. 5a-b. de Ryckholt, 1845, p. 60, pl. 4, figs. 9–16. Salter, 1847, p. 49. Bronn, 1848, p. 291. Bigsby, 1878, p. 319. Dall, 1882, p. 283. Rochebrune, 1883, pp. 31–32.

Chiton (*Chitonellus*) *cordifer* de Koninck. de Koninck, 1857, p. 196 (as "*condifer*"). Baily, 1860, p. 95.

Chitonellus cordifer (de Koninck). d'Orbigny, 1850, p. 127. Kirkby, 1862, p. 237 (footnote). Etheridge, 1882, p. 97.

Glyptochiton cordifer (de Koninck). de Koninck, 1883, p. 213; type species of *Glyptochiton* de Koninck, 1883, by original designation. P. H. Fischer, 1957, p. 12. Smith, 1960, p. 72, figs. 44, 5a-c (*ex* de Koninck, 1883).

Glyptochiton youngianus (Kirkby in Young, 1865)

Chitonellus youngianus Kirkby in Young, 1865, pp. 14–15, pl. 1, fig. 2. Kirkby and Young, 1867, pp. 341–342, pl. 16, figs. 2–4. Etheridge, 1882, pp. 101–102, pl. 2, figs. 23–24.

Chiton youngianus (Kirkby in Young). Rochebrune, 1883, pp. 33–34 (as "*yungianus*").

Glyptochiton youngianus (Kirkby in Young). Smith, 1960, p. 72, figs. 44, 6a-b (*ex* Etheridge, 1882).

Glyptochiton subquadratus (Kirkby and Young, 1867)

Chitonellus subquadratus Kirkby and Young, 1867, p. 342, pl. 16, fig. 5. Etheridge, 1882, pp. 96–97, pl. 2, figs. 4–5.

Glyptochiton quadratus (Etheridge, 1882)

Chitonellus sp. indet. Etheridge, 1882, pp. 97–98, pl. 2, figs. 6–7.

Chitonellus quadratus Etheridge, 1882, p. 98.

Glyptochiton kirkbyanus (Etheridge, 1882)
Chitonellus kirkbyanus Etheridge, 1882, pp. 100–101, pl. 2, figs. 14–22.

The preceding account of a peculiar group of Paleozoic chitons no doubt raises more evolutionary questions than can be answered with the small amount of factual information now at hand. Nevertheless, it is presented with the hope that more careful study of *Glyptochiton* valves preserved in European museum collections will be encouraged, and that new material can be collected in order that the basis for answering at least some of these questions can be provided.

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